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ABSTRACT

Media reports are an important source of new scientific knowledge, and this information can affect the decision making process. This study explores how formal educational settings prepare students to evaluate informal scientific information. Participants in this study came from different science backgrounds, including adults who did not study post secondary studies and university students from different majors. The differences among the participants were investigated. (YDS)

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Reading News Briefs About Science:

How Education is Related to the Questions People Ask

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Objectives and Theoretical Underpinnings

Media reports of scientific research are pervasive and a potentially important source of new scientific knowledge, not only for students who pursue careers in science-related fields but also for the general public (Wellington, 1991). Citizens in a democratic society can be called upon to contribute to policy issues such as acid rain or AIDS, and in doing so, they may require the skills necessary to critically evaluate media reports of scientific research. Furthermore, personal decisions, such as choice of medical treatment, can be influenced by information presented in the media. The prevalence of news reports and the importance of decisions based on scientific research presented in these reports makes evaluative skills an important component of science literacy and a valued outcome of contemporary science education (Glynn & Muth, 1994).

Researchers are showing increasing interest in the informal opportunities to learn about science afforded to the public by the media. Furthermore, research is being conducted on the skills necessary to evaluate scientific news reports critically (e.g., Korpan, Bisanz, Bisanz, & Henderson, 1997; Norris & Phillips, 1994). We have initiated research on how students read and evaluate media-style reports about scientific research. One goal is to describe developmental changes and individual differences in knowledge structures that can be represented in terms of constituent elements, relations among those elements, and patterns of activation. Theories of knowledge structures have played a major role in research on how information is represented and used in many domains (e.g., Chi, 1992) and are essential for improving instruction. In this study, we asked participants with differing numbers of science courses to evaluate brief media-style reports of scientific research. This research will help us characterize how knowledge acquired within formal educational settings prepares students to deal with scientific information presented in informal contexts.

A second goal of our research was to determine how evaluation of scientific news briefs is influenced by text characteristics. In a previous study (Korpan et al, 1997), we found tentative evidence that studentsí evaluation is influenced by differences along two dimensions: typicality, the degree to which the domain of the media report is related to phenomena normally studied in the science curriculum for university-bound students (e.g., biology, chemistry, physics); and plausibility, the degree to which conclusions stated in the reports are credible. In the present study, we systematically manipulated typicality and plausibility to determine the extent to which these dimensions influence the type of questions participants ask when they evaluated news briefs.

Participants

Four groups of adults with differing levels of science education participated in the study, adults who completed high school but had not pursued post-secondary studies at the time of the study (i.e., non-university participants, n = 34); first-year university students (n = 24); fourth-year university students majoring in English (n = 24); and fourth-year university students majoring in Psychology (n = 24). All university participants began their university program within a year of high school graduation. The age range of the adults who did not pursue post-secondary education matched the age range of the entire university sample. As indicated in Table 1, adults who pursued postsecondary studies have more science background at the high school level than those who did not go on to university. Among the three groups of university students, there were no significant differences in the number of science courses completed at the high school level. At the university level, however, Psychology majors had completed approximately six times as many science-related courses (i.e., the sum of university level courses completed in math & statistics, natural & physical sciences, and social sciences) as first-year students and English majors.

Table 1

Science Background as a Function of Educational Level

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	No University	1st-year University Students	4th-Year English Majors	4th-Year Psychology Majors
Semesters of High School Math	3.13	4.83	4.33	3.96
Semesters of High School Science	6.38	12.17	10.71	11.33
University Math & Statistics Courses	0	.88	.46	2.69
University-Natural & Physical Sciences Courses	0	2.04	1.58	3.63
University-Social Science Courses	0	1.54	.96	18.12
Total # of Courses	9.51	21.46	18.04	39.73

Materials and Methods

Each participant read media-style news briefs about scientific research in four domains, each having the following format: (a) a general concern or issue is described; (b) researchers report a finding; and (c) an independent group concludes that the finding is important for addressing the general concern or issue. The four news briefs represented orthogonal combinations of typicality (High, Low) and plausibility (High, Low). The news briefs are provided in the appendix. All students rated the typicality and plausibility of the conclusion reported in each news brief using a 7-point Likert scale. For Plausibility, the question was: How likely do you think it is that the reported conclusion is true? 1 = very unlikely, 7 = very likely. For Typicality, the questions was: How closely related is the conclusion to topics covered in the natural and physical sciences such as Physics, Chemistry, or Biology? 1 = very unrelated, 7 = very related. Their ratings confirmed our method of classifying news briefs and did not differ across the four groups.

Students were also asked to list questions that needed to be answered for them to decide whether the conclusion reported in each news brief was true and to justify their questions by explaining how knowing the answer to each question would help them determine whether the reported conclusion is true.

We used a comprehensive taxonomy developed by Korpan et al. (1994) to classify the questions and justifications. Only questions are discussed in this paper. The major topics in the taxonomy used to classify questions are described below.

1. Social Context includes questions about the people, institutions, and publication outlets associated with the research. These questions reflect an interest in issues of credentials, prestige, and bias related to who conducted, evaluated or promoted the research and where the research was conducted.

2. Theory includes questions about the properties of the treatments and mechanisms underlying the treatment effects reported in the news briefs. These questions reflect an interest in why the reported effects might have occurred.

3. Method includes questions about research design, procedures, subject selection, and measures. These questions reflect how the research was conducted.

4. Data includes questions about the data used to make the conclusions and about the statistical methods used to analyze or interpret the data. These questions reflect an interest in what was observed in the reported studies.

5. Related Research includes questions about findings from other relevant scientific studies. These questions reflect an interest in issues of replication and consensus.

6. Relevance includes questions about the importance, applicability, or generalizability of the findings or about the impact of the research. These questions do not help determine the truth of the conclusions, however.

Ratings and question-generation data were collected initially from university students and later from non-university participants. For each news brief, university students were given 20 minutes to rate the conclusion on four dimensions (plausibility, typicality, knowledge, and interest), justify their ratings, write down their questions, and justify their questions. Non-university participants were given 8 minutes to provide their ratings, generate questions, and justify their questions. They were not asked to justify their ratings. The time allocated to each of these tasks was determined by the participants.

Selected Results and Discussion

Group Effects

The first goal of this research was to determine how the range of questions generated and the salience of particular topics are affected by background in science. We investigated educational effects in a number of ways. First, we looked at how groups differed in terms of number of questions generated with regard to each topic across the four news briefs (See Table 2: Mean Number of Questions Generated as a Function of Educational Level and Topic). To control for possible differences in the time allocated to the question-generation part of the task, we also analyzed group differences in terms of proportions (see Table 3: Mean Proportion of Questions Generated as a Function of Educational Level and Topic). For example, *Social Context* was calculated by dividing the number of questions generated about social context across the four news briefs by the total number of questions generated. We also investigated the first two questions that participants generate when they evaluated all four news briefs (see Table 4) and the percentage of individuals who generated at least one question about each topic for *all* four news briefs (see Table 5). All four tables support the following trends.

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1. Across all 4 groups and 4 news briefs, questions were focused primarily on how the research was conducted (Method) and why the reported results occurred (Theory). These topics tend to be the most salient to participants, almost to the exclusion of other topics. In science, conclusions are closely linked to method and theory. Historically, concerns that students might not recognize these links may have resulted in an advocacy for process-oriented approaches to science education. The prevalence of questions about method and theory may reflect this approach in science classrooms.

2. Psychology majors generated more questions than the other 3 groups, with most of their questions focused on Method. Furthermore, first-year university students and English majors focused more of their questions on Method than those who did not continue on to university. This trend may be associated with differences in the number of science courses completed (See Table 1) and, therefore, differences in exposure to process-oriented approaches to teaching science (DeBoar, 1991).

3. Encouragingly, all groups demonstrated a high level of interest in why the reported results occurred by generating several questions about Theory. One possible explanation for this finding is that the amount of formal science education that most citizens attain in high school is sufficient to stimulate interest in theory and an awareness of its importance. Another possibility is that informal learning experiences may acquaint individuals with this aspect of science. Because media reports about science are pervasive, research focused on the nature of these reports is necessary to understand the role they play in informal learning and critical thinking about theory and other aspects of scientific activity (e.g., Zimmerman et al., in preparation). Other types of informal learning (e.g., visits to museums) may also play a role in familiarizing individuals with science and should be studied further (e.g., Dierking & Martin, 1997; Korpan et al., 1997).

Also noteworthy is the finding that non-university participants demonstrated more interest in Theory than university students. One possible explanation for this finding is that they have little familiarity with other issues, and therefore tend to focus on mechanisms underlying the reported effect.

4. Fourth-year Psychology and English majors directed more of their questions to issues concerning Social Context than the other two groups of participants. As Social Context issues are usually not emphasized in science classrooms, even at the undergraduate level, it is possible that students in both disciplines acquired this type of knowledge primarily through their general university experiences with various research communities.

Questions about social context were not varied, however. Questions were directed at who cthe researchers were and their qualifications, which reflects an awareness that scientific research takes place within a research community that can influence the selection of research questions and the interpretation and acceptability of results. Questions about where the research was conducted and how the research was funded were rarely asked by university participants, and never asked by non-university participants.

5. Disappointingly, all groups demonstrated a comparably low level of interest in quantitative aspects about what was found in the reported studies (Data) and how it is related to extant research in the scientific literature (Related Research). This finding was especially surprising for Psychology majors, given their course work and demonstrated ability to ask numerous sophisticated questions about Method. It seems that students, even those who have completed several science-related courses at the university level, need explicit encouragement to think about a variety of scientific issues when evaluating the credibility of research.

Table 2

Mean Number of Questions as a Function of Educational Level and Topic

	No University	1st Year University Students	4th Year English Majors	4th Year Psychology Majors	Average Across Education Level
Social Context	1.52	1.38	2.88	3.33	2.28
Theory	5.11	4.50	4.33	4.00	4.49
Methods	2.88	5.92	5.46	9.46	5.93
Data	1.62	1.88	1.33	2.13	1.74
Related Research	.35	.21	.21	.46	.31
Relevance	2.47	1.79	2.08	1.88	2.06
Total # of Questions	13.95	15.68	16.29	21.26	16.80

Table 3

Mean Proportion of Questions as a Function of Educational Level and Topic

	No University	1st Year University Students	4th Year English Majors	4th Year Psychology Majors	Average Across Education Level
Social Context	.11	.09	.18	.16	.14
Theory	.37	.29	.27	.19	.27
Methods	.21	.38	.34	.44	.35
Data	.12	.12	.08	.10	.10
Related Research	.03	.01	.01	.02	.02
Relevance	.18	.11	.13	.09	.13

Table 4

Mean Number of Times Each Topic is Mentioned in the First Two Questions of all Four News Briefs (8 Opportunities) as a Function of Group

	No University	1st Year University Students	4th Year English Majors	4th Year Psychology Majors	Average Across Education Level
Social Context	0.79	0.5	1.42	1.5	1.02
Theory	3.26	2.83	2.04	1.79	2.56
Methods	1.41	2.79	2.75	3.25	2.44
Data/Statistics	0.41	0.79	0.83	0.75	0.67
Related Research	0.12	0.04	0.08	0.04	0.08
Relevance	0.82	0.33	0.75	0.42	0.6

Table 5

Percentage of Individuals Makings at Least One Request for a Given Topic on *All* Four News Briefs

	Social Context	Agent/ Theory	Methods	Data/Statistics	Related Research	Relevance
No University	6	50	9	3	0	6
1st Year University	8	25	29	4	0	0
4th Year Psychology Majors	25	38	67	8	0	4
4th Year English Majors	29	25	25	0	0	0

The second goal of this research was to determine how the types of questions participants generated was affected by the text dimensions of Plausibility and Typicality. This was addressed by investigating the mean number of questions generated for each topic as a function of news brief (See Table 7). Two notable trends are discussed.

6. All four groups generated more questions for news briefs rated low in plausibility than news briefs rated highly plausible. Furthermore, the emphasis was on who conducted the research (Social Context) and the mechanism underlying the reported effect (Theory) for these news briefs.

7. For all groups, the text dimensions of Typicality and Plausibility interacted. When presented with a news brief reporting a counterintuitive finding (Low Plausibility) within the natural and physical sciences (High Typicality), participants requested information about Theory at the expense of asking questions about Method. Perhaps participants had sufficient confidence in the methodology used by the researchers to suspend questions about method in favor of questions that would help explain, for example, how a poisonous gasoline additive could reduce air pollution (To see the full news brief, see Appendix).

Table 7

Mean Number of Questions as a Function of News Brief Type and Topic

	Low Plausibility Low Typicality	Low Plausibility High Typicality	High Plausibility Low Typicality	High Plausibility High Typicality
Social Context	0.64	0.65	0.44	0.47
Agent/Theory	1.06	1.76	0.82	0.92
Methods	1.73	0.61	1.68	1.61
Data/Statistics	0.59	0.3	0.34	0.49
Related Research	0.22	0.9	0.53	0.45
Relevance	0.1	0.08	0.05	0.07
Total # of Questions	4.34	4.3	3.86	3.52

Educational and Scientific Importance

Reading in science courses, both at the high school and university level, is often confined to textbooks that recount established scientific findings (Bauer, 1992). In this age of communication, however, information about cutting-edge science is readily available in the visual and print media, presenting numerous and continuous opportunities to learn about new scientific research. In fact, for most high school and university graduates, learning about new scientific developments occurs largely within informal contexts, such as through exposure to media reports. Consequently, competence in evaluating media reports of science is important not only for students planning to enter professions related to science, but for all high school graduates. To date, the effects of high school and postsecondary science education on evaluative competency are not well understood. In the present study, we identified the types of information individuals seek when evaluating scientific news reports, and we investigated how their questions are related to levels of formal education in science and text dimensions.

We found that although all groups generated a variety of questions, the types of questions generated were constrained by the text dimensions of Plausibility and Typicality. We also found that high school science courses help to prepare individuals to think about some, but certainly not all, types of questions important for evaluating research. In fact, only questions about Theory were asked frequently by all groups. Frequent questions about other topics of research, such as Method, for example, were evident only in university students who were in the fourth year of their science program in Psychology. As our results suggest, however, even an undergraduate degree does not guarantee that individuals will think readily about all potentially important aspects of science when evaluating science news briefs (e.g., Data, Related Research). Given the importance of informal learning about science for effective citizenship, science educators at all educational levels must ask themselves how to help students think critically and broadly about all aspects of science that are important for assessing the significance of new scientific advances.

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Appendix- News Briefs

(Low Plausibility, Low Typicality)

People have long been interested in what the future holds. Researchers have reported that people who wear Ollinite crystals during sleep are more likely to have dreams that predict the future. Members of Mind Matters have hailed this finding and have concluded that wearing this crystal is important for increasing the frequency of dreams about future events.

(Low Plausibility, High Typicality)

People are concerned about the environmental effects of automobile emissions. Researchers have reported that vehicles that burn gasoline containing the poisonous chemical Quipmanol will reduce existing levels of air pollution. Members of Autos for the Future have hailed this finding and concluded that fueling vehicles with gasoline containing this poisonous chemical is important for decreasing current levels of air pollution.

(High Plausibility Low Typicality)

People in western countries have long been fascinated by traditional Eastern religious practices. Researchers have reported that senior citizens who practice Mai handu meditation show an increased sense of well being. Members of Lifestyles for Seniors have hailed this finding and have concluded that practicing this meditation is important for increasing the sense of well being in seniors.

(High Plausibility, High Typicality)

People are concerned that declines in wildlife populations will result in extinction for some species. Researchers have reported that robins that have been exposed to the insecticide Permaldrin are less likely to mate than usual. Members of Nature Unlimited have hailed this finding and have concluded that using this insecticide is an important factor in causing a decline in robinsí mating behavior.

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